JCI - Milford Branch

Process Hazard Analysis

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JCI JONES CHEMICALS, INC.
Process Hazard Analysis
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SECTION 1
INTRODUCTION AND SUMMARY

1.0 Purpose

This document is the Process Hazard Analysis for the JCI Jones Chemicals, Inc. (JCI) facility located at16248 Industrial Drive, Milford Virginia 22514.

1.1 Applicability

The Occupational Safety and Health Administration (OSHA) has issued regulations titled *Process Safety Management of Highly Hazardous Chemicals* in the workplace. These regulations are contained in Title 29, Code of Federal Regulations (29 CFR) section 1910.119 and apply to a facility that manages Highly Hazardous Chemicals (HHC's). An HHC is both listed by name by OSHA at 29 CFR 1910.119, Appendix A, and is stored at a facility in quantities at or above an OSHA specified Threshold Quantity (TQ). All JCI operating facilities (as contrasted to locations which are just offices) have one or more HHC's at the facility. The compliance guide for these regulations is contained in the JCI Safety Manual, Chapter 4.

One requirement of the standard, found at 29 CFR 1910.119(e), is that the facility must conduct a Process Hazard Analysis (PHA) for each Highly Hazardous Chemical (HHC). The PHA must determine and evaluate the hazards of the process being evaluated. It must address: hazards of the process: identification of previous incident(s) which had a likely potential for catastrophic consequences in the workplace; engineering and administrative controls and the consequences if they fail; facility siting; human factors; qualitative evaluation of the possible safety and health effects of failure of controls on employees in the workplace.

Each recommendation developed during the PHA must be communicated to the employees and the resolution of each recommendation is documented.

1.2 Methodology

JCI operates eleven facilities that are subject to this standard. The format and general content of the PHA was developed using industry standards and recommend practices (primarily those of the Chlorine Institute and Compressed Gas Association), corporate standard operating procedures, a generic hazard and operability (HazOp) study prepared by an outside consultant, and local conditions. The methodology is discussed in more detail in Section 11.

1.3 Facility Overview

The facility's primary function is to protect public health by supplying chemicals to disinfect bulk water systems. The primary operations conducted at this facility include the distribution of inorganic chemicals and repackaging of inorganic gases. Chemicals are brought on site in packages (drums, bags, etc.), bulk quantities (rail cars, tank trucks, etc.), repackaged into smaller containers, and then transported to customers on an as-needed-basis. Any residual compressed gas is absorbed in an appropriate solution and sold as product.

The HHC's, respective TQ's, and maximum amount in inventory at this facility are listed in the table below.

HHC	TQ	Maximum Inventory
Chlorine	1,500 pounds	360,000 lbs
Sulfur dioxide	1,000 pounds	24,000 lbs

The processes for the HHC's stored and handled at the facility are summarized below:

1. Chlorine repackaged and used to make sodium hypochlorite (bleach).

2. Sulfur dioxide is brought on site already repackaged.

All the HHC's are hazardous materials as defined by U.S. Department of Transportation (DOT). Thus, all containers and transportation equipment are regulated by the DOT.

This PHA has been prepared by and reviewed by the JCI Corporate Environmental, Safety and Risk Management Department, and the facility's PHA team.

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SECTION 2
FACILITY DESCRIPTION

2.0 Facility Description

JCI began operations at the Milford, Virginia facility in 1956. The following description of facility operations is based upon currently existing conditions.

2.1 Facility Location and Layout

The JCI facility is located in Caroline County on a 19.43 parcel of land at 16248 Industrial Drive, Milford Virginia. Currently, the facility is bounded by Bosnal Stone on the north, Keller Industries on the south, railroad tracks on the west, and Hoover Wood Products on the east. The facility is surrounded primarily by industrial areas, however, there are residential areas located approximately 1.5 to the south of the facility.

2.2 Facility Profile

The facility currently has a staff of 6 that includes salaried personnel, drivers, maintenance and clerical employees. The plant is in operation from 7:00am to 5:00pm five days per week.

The facility has one (1) building in which chlorine tons and cylinders repackaging, bleach manufacturing, administrative functions, and maintenance operations are performed, and dry goods are stored.

2.3 Site Topography and Meteorological Conditions

Most of the facility is located on level land, approximately 110 feet above sea level. The area receives precipitation approximately 140 days per year. Average annual precipitation is 42.8 inches. The average wind speed is 7.5 miles per hour. Temperatures average 33 °F in January, the coldest month of the year. Summer temperatures average 78.°F, though summer temperatures sometimes approach 104 °F.

2.4 Site Access

Entrance to the facility by motor vehicle is controlled by a (electronically controlled) gate. The CSX rail line is located on the north and west side of the facility. A rail spur enters the facility for rail car delivery of cholrine, sodium hydroxide, (caustic).

2.5 Regional Demographics

The facility is located in an industrialized area. Neighboring plants include Bosnal Stone 1\4 mile to the north, Keller Industries 1\4 mile to the south and Hoover Wood Products 1\2 mile to the east.

2.6 External Events of Concern

The facility is not located in either an earthquake, hurricane, blizzard, and or flood area.

2.7 Facility Siting

Facility Sitting, sometimes referred to as Stationary Source Siting, pertains to the requirement to consider the location of covered processes on Branch property relative to the potential impact on both onsite and offsite receptors, and of the risks associated with the release of any regulated substance from these processes. These factors were considered in the development of both the Worst and Alternate Case Scenarios in accordance with the EPA's Risk Management Program regulations and are discussed in detail in the Milford Branch's Risk Management Plan.

In addition, the Hazard and Operability Study (HazOp) and the corresponding "What If Hazards Analysis" contained in sections 11 and 12 respectively, of this document reflect consideration of the location of the repackaging, storage and distribution phases of each covered process.

Lastly, Section 6 (Detection and Monitoring) of this document discusses the various mitigation systems that have been installed at the Milford, Virginia Branch which serve to reduce the potential for catastrophic releases of the Highly Hazardous Chemicals handled at the Branch.

SECTION 3
HIGHLY HAZARDOUS CHEMICAL PROCESSES

3.0 Introduction

The facility handles one highly hazardous chemicals: chlorine. This section briefly discusses each chemical and the process associated with it. A more complete discussion is contained in the JCI Production (PR) and Engineering (EN) Manuals.

3.1 Chlorine

This process includes repackaging chlorine and the production of sodium hypochlorite (bleach).

3.1.1 Chlorine Repackaging Description

The chlorine repackaging process at the facility includes repackaging chlorine and the production of sodium hypochlorite (bleach). Detailed descriptions and schematic diagrams of the storage and handling of chlorine at the facility are included in the facility's Engineering Manual.

The facility receives chlorine in railcars. Each railcar is typically a 90-ton U.S. Department of Transportation (DOT) specification chlorine tank car. The railcars are used for storage. Railcars are delivered by CSX via a spur line. The spur provides storage for railcars. The spur generally contains no more than two (2) 90-ton chlorine railcars, although there is room for many more cars of chlorine. Typically, when a railcar is delivered, an empty one is removed.

Chlorine is repackaged from a railcar into 150-pound cylinders and 1-ton containers. Chlorine as a liquid (as contrasted to gas) is transferred from the railcar using air pressure. The plant air used to pressurize (pad) the tank car is supplied by an air compressor and must be dried to -40°F dew point. Air pressure of approximately 180 pounds per square inch (psi) is used to pad the chlorine railcar.

Liquid chlorine is forced out through a 1-inch carbon steel line. Chlorine is transferred through this line to a header, which distributes the chlorine to the cylinder and ton filling stations, and to the bleach production area. The pressure at the filling stations averages 140 psi.

In preparation for filling, returned chlorine cylinders and ton containers are blown down, a vacuum is applied, and the valve(s) removed. A rebuilt or new valve is installed.

The liquid and gas vapor from the blown-down operations is transferred through a closed-loop system to the chlorine blow-down tanks for use in the manufacture of sodium hypochlorite. The gas vapor from vacuum operations is transferred through a closed-loop system to the vacuum ton for use in the manufacture of sodium hypochlorite.

Valves are rebuilt on site by disassembly and inspection and cleaning of all parts both internally and externally by mechanically driven brushes. They are then re-inspected, reassembled, and pressure-tested at 500 psi with nitrogen in a water bath.

Once the new or rebuilt valve is installed, the container is positioned on a scale to be filled with liquid chlorine. The filling station allows for liquid filling as well as product removal by closed-looped blow-down and vacuum systems. Each ton scale is equipped with an automatic scale shutoff when the scale has reached a pre-programmed weight. The scales are checked daily using a container of known weight. An outside contractor, Security Scale, checks the scales annually.

Full containers are stored for subsequent distribution to customers by tractor-trailer. All drivers and members of the yard crew are trained in loading and unloading these containers.

In some instances, customers use their own trucks to return empty and pick up full containers. Common and contract carriers are also used for chlorine delivery.

Containers are hydrostatically tested every five years in accordance with DOT specifications.

All chlorine-handling equipment in use at the facility complies with recognized and generally accepted good engineering practices.

3.1.2 Manufacture of Sodium Hypochlorite (Bleach)

Sodium hypochlorite is produced at strength of 12.5 percent by reacting chlorine with dilute sodium hydroxide (caustic soda). The dilute caustic soda is circulated through a pump system as chlorine is injected into the solution. Monitoring devices are used to verify the finished product. The finished product is pumped either to bulk storage tanks or directly into a tank truck for delivery.

Vapors generated by degassing (blowing down) returned chlorine containers and the blow-down and vacuum steps that occur during cylinder-filling operations are piped to collection tanks (surge tons) and then to vats that contain a dilute solution of sodium hydroxide. The chlorine reacts with the caustic soda to produce bleach. In addition, chlorine from the railcars can also be piped to these vats. When the reaction is complete, the solution is then pumped to bulk storage tanks or directly into a tank truck for delivery.

From storage, the bleach is pumped to containers for shipment. Transfer is through schedule 80 polyvinyl chloride pipes and by polyethylene transfer hoses. Bleach is shipped in 15- and 55-gallon drums, 220- and 330-gallon totes, as well as by DOT specification lined tank trucks. At the present time, the facility produces bleach for the next day's shipment and retains very little bleach in inventory.

All sodium hypochlorite handling equipment in use at the facility complies with recognized and generally accepted good engineering practices.

3.2 Sulfur Dioxide

This process consists solely of the stored for subsequent distribution to customers by truck. All drivers and members of the yard crew are trained in loading and unloading these containers.

Containers are hydrostatically tested every five years in accordance with DOT regulations.

All sulfur dioxide handling equipment in use at the facility complies with recognized and generally accepted good engineering practices.

SECTION 4
CHEMICAL HAZARDS

4.0 Overview of Chemical Hazards

There are Material Safety Data Sheets (MSDS) available for all chemicals on site covered by the OSHA Hazard Communication Standard. A complete set is kept in the main office, plant break room, and the red mailbox at the front gate for emergency responders. Applicable MSDSs are also kept in individual work areas. The Branch Manager has the responsibility for ensuring that MSDSs are current. The Highly Hazardous Chemicals handled at the facility are all classified as hazardous materials by the US Department of Transportation (DOT). This means that the containers used to ship the HHC's are regulated by the DOT. Following is a very brief overview of the hazards of the HHC's and their processes at this facility.

4.1 Chlorine (Cl_2)

Chlorine (CAS #7782-50-5) is a greenish yellow gas with a pungent suffocating odor, detectable at concentrations of 0.5 ppm or less. Its boiling point is -30.3°F. The American Conference of Governmental Industrial Hygienists (ACGIH) has established a threshold limit value 8-hour time-weighted average (TWA) of exposure to chlorine at 0.5 ppm. ACGIH has established a threshold limit value short-term exposure limit (STEL) of 1 ppm for exposure to chlorine. The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) ceiling concentration is 1 ppm. In 1994, the National Institute for Occupational Safety and Health (NIOSH) reduced its Immediately Dangerous to Life or Health (IDLH) concentration for chlorine to 10 ppm. The DOT and EPA reportable quantity (RQ) value is 10 pounds. The DOT classifies it as Division 2.3 (Poison Gas), and as a Poison Inhalation Hazard, Zone B.

Chlorine is a poison gas stored under pressure as a liquid. The vapors are heavier than air and tend to settle in low areas. It is corrosive to eyes, skin and mucous membranes in the presence of moisture. It may be fatal if inhaled. Do not breathe air containing chlorine. Do not get chlorine in eyes, on skin, or clothing. Keep containers away from intense heat or open sunlight. It is corrosive to most metal in the presence of water.

4.2 Sodium Hypochlorite (NaOCl)

Sodium hypochlorite (CAS #7681-52-9) is a greenish yellow liquid with a characteristic odor. The DOT and EPA reportable quantity (RQ) value is 100 pounds. The DOT classifies it as Class 8 (Corrosive), Packing Group III.

Sodium hypochlorite decomposes naturally. Contact with acids will liberate chlorine that is irritating to eyes, lungs, and mucous membranes. Contact with other chemicals or organic matter may liberate chlorine or other harmful gases. It is corrosive and may cause severe skin irritation or chemical burns to broken skin. It causes eye damage, and is toxic to fish.

4.3 Sulfur Dioxide (SO_2)

Sulfur dioxide (CAS #7446-09-5) is a yellow gas with a pungent suffocating odor, detectable at concentrations of 3-5 ppm. Its boiling point is 14°F. The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) concentration is 5 ppm as an eight-hour time weighted average (TWA). The NIOSH Immediately Dangerous to Life or Health (IDLH) concentration is 100 ppm. The EPA (SARA Title III) reportable quantity (RQ) value is 500 pound. There is no DOT RQ. The DOT classifies it as Division 2.3 (Poison Gas), and as a Poison Inhalation Hazard, Zone C.

Sulfur dioxide is a gas stored under pressure as a liquid. The vapors are heavier than air and tend to settle in low areas. It is intensely irritating to the eyes and respiratory tract causing burning of the eyes and tearing, coughing and chest tightness. It may cause severe breathing difficulties.

4.4 Sodium Bisulfite ($NaHSO_3$)

Sodium bisulfite (CAS #7631-90-5) is a light, straw colored liquid with a sulfur dioxide odor. The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) concentration is 5 mg/m^3 as an eight-hour time weighted average (TWA). The DOT and EPA reportable quantity (RQ) value is 5,000 pounds. The DOT classifies it as Class 8 (Corrosive), Packing Group III.

Sodium bisulfite solutions are acidic. It causes eye, skin and respiratory tract irritation.

SECTION 5
DESIGN

5.0 Design Controls

Prevention of HHC releases requires proper design. This facility has been designed with a number of features to prevent and control potential HHC releases. This section presents a description of the release detection, prevention, and control measures at the facility. The chlorine system has been designed based on the recommendations of the Chlorine Institute. Further details are available, including reference documents, in the JCI Engineering Manual, Volumes I & II.

5.1 Release Prevention Control Systems

The United States Department of Transportation (DOT) regulates both the allowable containers that can be used for the HHC's and their design. The DOT regulations are found in Title 49 Code of Federal Regulations.

Various release prevention devices are incorporated into the design of rail cars utilized to transport chlorine or sulfur dioxide to the facility and into the design of containers/cylinders into which the gases are repackaged.

5.1.1 Rail Cars

The tank cars that may be utilized for the HHC's at this facility are contained in the DOT regulations at 49 CFR 173.314. The specifications for single unit tank car tanks are contained in the DOT regulations at 49 CFR 179.100.

5.1.1.1 Pressure Relief Valves

A pressure relief valve is located on the top of the rail car in the center of the man way cover. It is designed to vent when the internal rail car tank pressure exceeds 225 psig for type 105A300W rail cars or at 375 psig for type 105A500W rail cars. The venting of either chlorine or sulfur dioxide vapor in this manner prevents a major buildup of pressure within the rail car's tank that could result in a catastrophic failure. Once pressure is reduced below the set point the valve reseats. This minimizes the amount of vapor released.

5.1.1.2 Excess Flow Valves

Under each liquid valve there is an excess flow valve. The excess flow valve consists of a rising ball which closes its valve when the rate of flow exceeds 7,000-pounds/hour, 11,000-pounds/hour, or 15,000-pounds/hour depending upon the type of rail car. The operation of this valve is not dependent upon the internal pressure of the rail car tank. Rather, it is designed to close automatically against an excessive flow of liquid.

5.1.1.3 Ton Container (Multi-Unit Tank Car Tanks)

Ton containers are regulated by the DOT as multi-unit tank car tanks, even though they are usually transported by truck. The multi-unit tank car tanks that may be utilized for chlorine or sulfur dioxide at this facility without an exemption are listed in the DOT regulations at 49 CFR 173.314(c) and 173.23(a). The specifications for multi-unit tank car tanks are contained in the DOT regulations at 49 CFR 179.300.

All ton containers are equipped with fusible metal pressure relief devices. Most have six fusible metal plugs, three on each end, spaced 120° apart. The fusible metal is designed to melt between 158°F and 165°F to relieve pressure and prevent rupture of the container in case of fire or other exposure to high temperature.

The ends of the containers are concave, designed to "bulge" when over-pressured thus increasing their capacity. They are hydrostatically tested every five years to 500 psi. They are filled by weight to 80% of water capacity. At 155°F, ton containers would be skin full of liquid.

5.1.2 Cylinders

The cylinders that may be utilized for the HHC's at this facility are contained in the DOT regulations at 49 CFR 173.304(a)(2). The specifications are contained in the DOT regulations at 49 CFR 178, Subpart C.

5.1.2.1 Pressure Relief

All cylinders are equipped with a fusible metal pressure relief device. Most valves have a threaded plug containing the fusible metal screwed into a tapped hole in the valve body, below the valve seat. The fusible metal is designed to melt between 158°F and 165°F to relieve pressure and prevent rupture of the container in case of fire or other exposure to high temperature.

Chlorine and sulfur dioxide cylinders are hydrostatically tested every five years to 500 psi. They are filled by weight to 80% of water capacity.

5.1.3 Piping System

5.1.3.1 Material of construction

The piping used for chlorine and sulfur dioxide is carbon steel per ASTM A 106-90, Grade A or B, 3/4 inch to 1 1/2 inch Schedule 80.

An in-service corrosion test has been conducted for the corporation. After at least three years of chlorine service under normal operating conditions, the pipe meets the tolerances for new pipe. The corrosion rate for test coupons was calculated as outlined in ASTM G 1-90 to be less than one (1) mil per year, correlating to a 10-year inspection or replacement interval for the pipe to remain within specification.

5.1.3.2 Expansion chambers

There are expansion chambers in the liquid chlorine and sulfur dioxide systems piping to prevent a piping rupture if liquid chlorine and/or sulfur dioxide were to be trapped between isolation valves and subsequently expands. These expansion chambers are located between isolation valves in any piping run that is over 100 feet long.

5.2 Isolation Systems

5.2.1 Valves

Other release prevention devices include isolation systems. Flow control valves are placed at strategic locations throughout each HHC process to direct the HHC flow depending upon plant operating conditions. These flow control valves also serve to isolate portions of the system in the event of component malfunction or line failure. Thus, rail cars, filling stations, and various transfer line segments can be isolated by operating strategically located valves.

Quick shutoff valves are installed on both ends of the chlorine supply piping.

5.2.2 Barometric Loop

There is a barometric loop between the chlorine tank car and the bleach vats to prevent bleach and caustic from backing up into the chlorine supply system from the bleach vats.

5.3 Release Containment Systems

5.3.1 Diking

Release containment devices incorporated into the design of the plant are primarily for spill containment. The bleach and sodium bisulfite storage tanks are located in separate concrete containment areas designed to hold a minimum of 110% of the contents of the largest tank.

Dikes are employed throughout the facility wherever liquids are handled or stored.

5.3.2 Vent Scrubbers

The facility has vent scrubbers to control fugitive emissions to the atmosphere. The emissions from sodium bisulfite manufacturing are absorbed in dilute caustic soda that is then reused in sodium bisulfite production. The emissions from bleach manufacturing are absorbed in dilute caustic soda that is then reused in bleach production.

5.4 Fire Protection System

Fire extinguishers are located throughout this facility. A complete list of the location and type of fire extinguishers is contained in the facility's Contingency Plan Manual.

SECTION 6
DETECTION AND MONITORING

6.0 Introduction

The facility has a number of detection and monitoring devices (i.e., mitigation systems) that minimize the risk of incidents involving HHC's. These include:

6.1 Vacuum Alarm System

The vacuum alarm system is designed to alert Plant employees in the event that the vacuum system fails; i.e., the chlorine and or sulfur dioxide lines are positively pressurized. This can occur as a result of excessive pressure being applied through the vacuum system; i.e., feeding liquid chlorine directly into the vacuum line, or if the vacuum pump shuts down. The loss of this vacuum capability, in the repackaging process, presents several opportunities for accidental product release and particularly while unhooking railcars and containers, notwithstanding other precautionary devices (gauges). The design is simple; a pressure switch (set at 1 lb. PSI for both chlorine and sulfur dioxide) constantly monitors the vacuum line for a vacuum at the point of entry on the fill station side of the vacuum surge ton (vacuum reservoir). If a vacuum is lost due to error or malfunction, the pressure switch will activate an automatic shut-off valve in the vacuum line and activate an audible alarm to alert operators of this abnormal production condition. The fill and process manifolds present the only opportunity for the vacuum line to be positively charged with either chlorine or sulfur dioxide gas. The activation of this alarm does not indicate a release or an emergency condition. An activation of this alarm does, however, provide notification of an abnormal condition and therefore, requires immediate operator and supervisory attention to determine the cause.

The operator(s) will then suspend unhooking containers until a vacuum is restored. As the pressure in the vacuum ton drops, the pressure switch will read this and send a signal to the solenoid that will then open the actuated valve. This process will be automatically repeated until a vacuum has been reestablished in the transfer system. The alarm parameters are as follows:

Chlorine	1 PSI
Sulfur Dioxide	1 PSI

6.2 Vat Control System

The vat control system is designed to prevent over-chlorination or over-sulfonation of the bleach and sodium bisulfite 'make' vats respectively, during the manufacturing process. The vat control system monitors both the excess caustic and pH in the bleach blow vat and sodium bisulfite make vat systems respectively as well as the temperature of the product in both systems during the production process and works in two stages. Stage one rings a "production alarm" when the vat has reached pre-set ORP/pH and or temperature readings. The operator then manually shuts down the flow of chlorine or sulfur dioxide, depending on the product being made. The second stage of this system consists of an "emergency shutdown" and also includes an audible alarm. While the set-points for bleach and sodium bisulfite production are set well below and above the product conditions that would cause over-chlorination or over-sulfonation respectively, the system itself will automatically close all actuated valves thereby stopping the flow of chlorine or sulfur dioxide into the vats once the second set of pre-set ORP/pH and or temperature parameters are met. The system is designed such that it cannot be manually reset or overridden as long as the "emergency shutdown" parameters exist. The parameters listed below are fairly representative of those at the Branches but it's important to point out that these settings are not identical at all eleven Branches.

	Production Alarm	Shutdown
Bleach	500 mv (ORP)/85°F	560 mv (ORP)/95°F
Sodium Bisulfite	5.0 s.u. (pH)/110°F	3.5 s.u. (pH)/120°F

As with the railcar monitors, the vat control system must be secured so as to prevent access to either the electrical components inside the cabinets themselves and/or the ORP/temperature controller and pH/temperature settings for the bleach blow vat and the sodium bisulfite make vat systems respectively by anyone other than maintenance personnel and or personnel authorized by the Branch Manager.

Note: In the event of a shutdown due to a chlorine or sulfur dioxide release, we want to retain the ability to open the actuated valves in the blow or liquid lines at the blow (bleach) or make (bleach or sodium bisulfite) vat(s). In order to accomplish this, it is mandatory that a 'bypass' switch be installed that can be used to open the actuated valve in either system in order to avoid a pressure buildup in the piping system. The exception to this of course is if the leak is in the system after the actuated valves; i.e., in the sparger tube(s).

6.3 Gas Detection System

The railcar monitoring and plant sensors systems are designed to identify a release of chlorine and/or sulfur dioxide either at the railcar(s) or throughout the Plant and shut down the flow of product at its source (i.e., the railcar, filling stations, container storage area, etc.). **Note:** *The activation of any of the manual e-stops strategically located throughout the Plant will also serve to shut down the flow of product from the railcars to the filling stations, bleach machine (if applicable), and the blow/make vats.* The key component of the gas detection system is the sensors located in close proximity to each railcar, production, and storage areas. The sensors are programmed with two settings as referenced below; a 'warning' condition and a 'shutdown' condition. If a release is detected, the system will sound an alarm indicating that the 'warning' condition has been achieved. Should the release meet the pre-established 'shutdown' conditions, the actuated valves on the railcar, the airlines going into the railcar, the header valve on the main manifold leading into the Plant, and all actuated valves, excluding that on the vacuum alarm system, in the chlorine and sulfur dioxide piping systems throughout the entire Plant will close. The alarms sound and the valves close at the following settings:

	WARNING	SHUTDOWN
Chlorine	1.0 ppm	2.5 ppm
Sulfur Dioxide	2.5 ppm	5.0 ppm

It is important to keep in mind that the conditions that set off the alarms in the first place must be identified and addressed before resetting the system. It is appropriate to note here that the 'warning' parameters may be either 'latching' or 'non-latching' dependent on system equipment design. In a 'latching' configured system, the system must be manually reset but at the same time, can only be reset after the condition causing the alarm has gone away whereas in a 'non-latching' system, the system will reset itself automatically when the condition identified by the sensor goes away. It is also appropriate to note here that the 'shutdown' parameters must be latching. The monitor itself should be secured so as to prevent access to the settings. A "remote" reset button should be mounted externally to the monitor which will eliminate the need to gain access to the system settings unless absolutely necessary. It should be understood that with the exception of maintenance personnel performing system checks or maintenance on the monitors and or designated employees so authorized by the Branch Manager, no one should be permitted to alter system settings.

6.4 Plant Emergency Stops (E-Stops)

In addition to the mitigation system components discussed above that electromechanically monitor and detect shutoff conditions, it may be necessary to initiate a shutdown condition based on prudent and necessary operator observation. For this this reason, each JCI facility has installed several Plant Emergency Stops (E-stops or Panic Buttons) that are tied directly into the existing gas mitigation systems. The activation of this system triggers an audible and/or visual alarm. By pushing one of these buttons, an employee can shut down every actuated valve in the entire chlorine and sulfur dioxide transfer system(s) with the exception of the vacuum alarm. Clear and unobstructed access to these buttons is to be maintained at all times. They must also be clearly marked and all employees must be made aware of the location of the E-stop closest to their work stations. Ideally, the E-stops should be located at the primary egress routes from the production building(s).

6.5 Backflow Prevention System

The purpose of the backflow prevention system is to prevent chlorine or sulfur dioxide from coming back into the "pad" air system and compressor. Being a compressed gas, there is always pressure on a railcar. If the Plant "pad" air system should lose pressure, it would be possible that the car pressure could exceed that of the "pad" air system thus allowing product to back up into the air system. The system is comprised of two (2) actuated valves, a solenoid valve, two (2) pressure differential switches, one pressure switch and a control panel. The pressure differential switches are designed to maintain a pressure differential of greater than or equal to 5 psi on the compressor side relative to the railcar side. The purpose of the pressure switch is to shut off both actuated valves when the pressure at the railcar has reached the pre-determined set point. A pressure differential of less than 5 psi will close both actuated valves. In order for the actuated valves to remain open, both conditions; a pressure differential greater than or equal to 5 psi and less than the pre-determined set point on the railcar side, must exist; otherwise, both valves will remain closed.

Pad Air Side: At least 5 PSI greater than the railcar side.

6.6 Auto-Dialer Alert System

The auto-dialer alert system is a recent addition to our already comprehensive mitigation system and is designed to augment the Gas Detection System. This system is tied into the gas detection system and specifically the 'warning' parameter such that during non-working hours and in the event the 'warning' parameter is achieved, a pre-programmed sequence of Branch employee phone numbers will be dialed to provide notification that a sensor has detected gaseous fumes of some type. The responding employee will acknowledge the notification via phone and report to the Branch to determine the source of the problem. As discussed above in paragraph 1 (Railcar Monitoring and Gas Sensors System), the 'warning' parameter may be either 'non-latching'; i.e., the alarm will cease to sound on its own when the condition causing the alarm to sound in the first place has gone away or 'latching', meaning that the system must be manually reset but can only be reset after the condition causing the alarm to sound in the first place has gone away.

6.7 Ultrasonic Tank Level Monitoring System

All product tanks, to include both storage and production (make) vats, are equipped with ultrasonic tank level monitoring systems. The tank-level monitoring system is designed such that low-level and high-level audible alarms will alert an operator when the tank has reached its pre-set low condition and or high condition set points. In the event of a low level condition, the alarm will help to ensure that pumps are not run dry, thereby damaging them and resulting in costly repairs. The low level condition alarm will signal the need to switch to another tank, shut down the process, or either produce or order more product. Lastly, it will serve as a warning in the event of a tank failure.

The high-level alarm will alert the operator that the tank is almost full or has the desired amount of product in the tank and therefore serves to prevent the tank(s) from being overfilled.

Note: The following points apply to the three mitigation system components discussed above in paragraphs 6.1, 6.2, and 6.3.

a. Once a shutdown condition is reached and the system has shutdown, it cannot be reset until the condition causing the activation has been satisfactorily corrected or eliminated.

b. The control panels (quadscans, XPLs, DPLs, ORP/pH controllers) must be secured so as to prevent tampering or unauthorized adjustments to the pre-set parameters by anyone other than either maintenance personnel or employees designated by the Branch Manager, again, while in the course of performing system checks or required maintenance.

c. Systems must be installed in a location such that unobstructed access and viewing is always provided.

d. Systems must be configured such that a controller cannot be reset as long as the condition initiating the shutdown continues to exist.

6.8 Automatic Scale Shut-off

The purpose of this system is to prevent either a ton or cylinder from being overfilled during the filling process. All ton and cylinder scales operate actuated valves that will shut off the flow of chlorine or sulfur dioxide when the scale has reached a pre-programmed weight. The weight is pre-programmed by the operator and is dependent on the amount of product desired. This system is also equipped with a panic button that will allow an operator to shut down the supply of chlorine or sulfur dioxide to the manifold in case of an emergency. There are a couple of points that should be addressed with those employees responsible for filling tons and cylinders. First, the set points should be checked daily while conducting the scale check. It is important that the indicator is "zeroed" each time before placing the next container onto the scale. To ensure accuracy, the weight reflected on the indicator after connecting the container should be "zeroed" (tare weight) again prior beginning to fill the container. **Note:** At no time during the filling process should the operator leave the area.

SECTION 7
OPERATIONS

7.0 Standard Operating Procedures

JCI has developed and implemented standard operating procedures (SOPs) for the operation of each HHC process. These procedures include an SOP for product filling and transfer, an SOP for Railroad operations, an SOP for Compressed Gas Container Testing and Inspection, and an SOP for Repackaging of Compressed Gases. These SOPs are contained in the Corporate Production Manual, the Corporate Maintenance Manual, and the Corporate Engineering I and Engineering II Manuals.

No locally prepared instructions, other than a part of the Contingency Plan, are available since all JCI facilities are essentially similar in process and products. Local input is solicited on changes and new best practice procedures before they are enacted corporate wide. These detailed manuals were first issued in 1988 to consolidate information and are updated on an as needed basis.

7.1 Department of Transportation (DOT) Regulations

The HHC's handled at this facility are Hazardous Materials as defined by the DOT. The DOT regulations are found in Title 49 Code of Federal Regulations (49 CFR).

7.1.1 Compressed Gas Containers

The HHC compressed gas containers (including rail cars) are all regulated by DOT. The regulations include requirements for manufacture, use, and visual inspection. Chlorine and sulfur dioxide containers must be hydrostatically tested every five years. Cylinders must be retested by a certified retester at 5/3 service pressure (800 pounds). Ton containers are retested to their service pressure, 500 pounds.

The regulations specify the filling density as a percent of water capacity verified by weight.

To assure compliance with these regulations, the facility tracks all containers by their serial number when testing, filling and shipping. Each scale is check weighed daily by facility personnel and the results recorded. An outside contractor services the scales annually.

7.1.2 Liquid Containers

The liquid containers for HHC process chemicals are all regulated by the DOT. These regulations include drums as well as tank trailers.

7.2 Shut Down Procedure

When the plant is not in operation, the rail cars are disconnected. Gas in the pipelines is removed through the vacuum systems.

7.3 Equipment Inspection and Maintenance Program

A program of periodic equipment inspection and maintenance has been implemented. This program consists of a variety of inspection grid maintenance frequencies and procedures ranging from rounds of the plants conducted on every shift to annual instrumentation testing of major equipment. Inspection requirements are detailed in the Mechanical Integrity Program binder.

The facility uses a manual work order system for routine maintenance. One employee is dedicated to maintenance for routine repairs. Outside contractors are used for servicing forklift, air compressors, scales, fire extinguishers, electrical work, and other major projects. Servicing is done according to JCI's specifications.

7.4 Color Code

All piping and containers are color coded to facilitate immediate identification.

7.5 Backups and Redundancy

See Section 6 - Detection and Monitoring.

No emergency generator or other backup power system is provided for a general power failure. All operations would be shut down and disconnected.

Excess caustic is always maintained in a vat to absorb either chlorine or sulfur dioxide from the respective blow down piping when filling cylinders and containers.

There is diking and berms around tanks and truck loading and unloading stations. Any spillage is collected and pumped to the ENS where it is batch treated before discharge.

7.6 Site Security Program

JCI has an extremely comprehensive Security Plan written in accordance with guidance provided by the Corporate Office, the Department of Transportation's regulations pertaining to security (HM 232) dated March 25, 2003; the Department of Homeland Security's Chemical Facility Anti-Terrorism Standards (6 CFR 27) issued on April 9, 2007 and the Transportation Security Administration's Rail Transportation Security Regulations (49 CFR Parts 1520 and 1580) dated November 26, 2008. The purpose of the JCI Jones Chemicals Inc. Security Plan is to establish a policy and standard operating procedures which will not only serve to enhance employee awareness with respect to security issues but minimize the potential impact on JCI personnel, facilities, equipment, processes and products as a result of unlawful acts either made or attempted by individuals seeking to harm personnel, property and or the environment. As stated in our Security Policy, we are committed to the continuous improvement of this program and will make every effort to develop and implement measures designed to maintain the highest level of security possible at all JCI facilities.

JCI's Security Plan covers a broad spectrum of topics and scenarios, to include the control of visitor access to the Branch and or Corporate Office. In accordance with JCI's Security Plan, no visitors are allowed onto Branch property without a prior appointment approved by the Branch Manager. Visitors permitted onto Branch property are required to register at the plant office and record their name, company or organization represented, purpose of the visit, time in and time out in the Visitor's Log. If they are visiting the plant, our Safety rules must be explained to them and they must be provided with a Visitor's Pass as well as personal protective equipment; i.e., safety glasses and an escape respirator.

SECTION 8
SAFETY, HEALTH, and ENVIRONMENTAL MANAGEMENT

8.0 Safety, Health, and Environmental Program

Safety and environmental issues are coordinated by the JCI Corporate Office.

The safety and health program is contained in the Corporate Safety Manual and the Safety Training Manual. The environmental program is contained in the Environmental Manual and the Quality Manual.

Fire extinguishers, gas masks, eyewash, and shower stations are located throughout the facility. Employees are required to wear safety glasses, bump caps (optional), and steel-toed shoes, and carry escape respirators. Additional function specific personal protective equipment is provided as required.

8.1 Facility Role in Process Safety Management

Daily safety and environmental matters are handled at the local level by the Branch and Plant Managers. All employees must attend a monthly safety training meeting. Employee suggestions are welcomed and encouraged.

8.2 Accident Prevention Program

The purpose of this program is the elimination of all accidents. It consists of two parts: hazard control and accident/incident review. The purpose of hazard control is to identify workplace hazards before they cause an accident. Accident/incident review determines the causes of accidents/incidents and finds ways to eliminate these causes in order to prevent a recurrence. Together, hazard control and accident review increase the safety of the workplace.

8.2.1 Hazard Control: Job Safety Analysis (JSA)

Hazards must be identified before they can be controlled. The National Safety Council (NSC) Job Safety Analysis (JSA) has been implemented to identify potential hazards. Once identified, JSA emphasizes hazard elimination, or reduction, or education of the employee about the hazard. It is very similar to the Hazard and Operability "What If" process except it is focused on people rather than product releases. Plant production and transportation employees, selected by the facility management and working directly with their immediate supervisor, are responsible for completing JSA's.

8.2.1.1 Methodology

The basic method includes breaking a job into logical steps, identifying potential hazards, and developing recommendations to mitigate potential hazards. Each step accomplishes some major task. Each task will consist of a set of movements arranged in logical order. Everything related to that one logical set of movements is part of that job step. Some steps may not need to be done each time. However, if a step is part of the job as a whole, it is listed and analyzed.

Each step is examined to find and identify hazards: the actions, conditions and possibilities that could lead to an accident. Potential hazards, including health hazards, are identified by analyzing the operation and asking "what if" questions.

Finally, recommendations are developed. A standard form has been adopted to assist in completing a JSA. It has three (3) columns. First the steps are listed. Then the hazard. Finally, the actions that are necessary to eliminate or minimize the hazards that could lead to an accident, injury, or occupational illness.

Among the actions that can be taken are:

1. Engineer the hazard out of the task.

2. Provide personal protection equipment.

3. Provide job instruction training.

4. Good housekeeping.

5. Good ergonomics (positioning the person in relation to the machine or other elements in the environment in such a way as to eliminate or reduce stresses and strains).

6. Administratively control the process to eliminate the hazard.

Recommended safe operating procedures are entered on the form, including a list of required or recommended personal protective equipment for every hazard. If a hazard is corrected, the JSA is then changed to reflect the new conditions.

Once a JSA is completed for a particular job, it is reviewed by the Branch Manager for accuracy and content. A copy is then forwarded to the Corporate Safety Department for final review and approval and distribution to other JCI facilities utilizing the same process.

JSA's for the HHC's at this facility are maintained as part of the facility audit.

8.2.2 Accident Review

The purpose of an accident review is to gather information concerning an accident or near miss so that the cause of the accident may be identified. It is NOT the intent of the accident review to place the blame.

It consists of three stages:

- The accident investigation;
- Implementation of recommendations; and
- Monitor.

8.2.2.1 Accident Investigation

All employees have been instructed to and are required to report any incidents including accidents and/or near misses to their supervisor as soon as possible and no later than the end of the shift on which it occurs. Employees involved in an incident will participate in the investigation, at least to the extent of contributing to a witness statement.

Incidents are investigated using a Standard Accident Investigation Procedure. The investigation must be started within forty-eight (48) hours of the incident, and the written report must be completed as soon as possible.

The Branch Manager is the senior investigator in the event at an accident, incident or near misses. In his/her absence, the Plant Manager and, in turn, the Foreman assumes this responsibility. An investigation report is also submitted to the JCI Corporate Office. When conditions warrant, the corporate office personnel join in the investigation. Results of the investigation are discussed during the facility's monthly safety training meeting.

The investigator will fill out the Accident Investigation Report Form based on an investigation and on the comments made by the witness(es). At a minimum, questions listed in the Questioning Guide will be asked of all witnesses during the course of the investigation. The completed report and any supporting documents are forwarded to the Branch Manager for review.

The Branch Manager and/or his/her designee is responsible for investigating the incident. Employees are responsible for assisting the Branch Manager with the investigation. It is the Branch Manager's duty to review the investigation report and to determine corrective actions to be taken in order to avoid a recurrence of the incident.

8.2.2.2 Implementation of Recommendations

Once recommendations for corrective action have been decided upon, the Branch Manager assigns responsibility for implementation. The effectiveness of the corrective actions is then discussed during the next monthly safety training meeting.

8.2.2.3 Monitor

The Branch Manager then ensures the implementation and effectiveness of recommendations by monitoring the actions.

8.3 Site Inspections

This section summarizes the self-inspection and review process that has been implemented.

8.3.1 Daily

Rounds of the plant are conducted continually by operators, supervisors, and the Branch Manager. The purpose of these rounds is to perform a cursory visual inspection of each system for indications of malfunction. Readings on the pressure, temperature, flow indicators, etc., are discussed with fill station operators at this time to ensure that they are operating properly.

8.3.2 Weekly

The Branch Manager or a designated employee must inspect the site weekly and prepare a written report. The process is detailed in the Environmental Manual, Section XXII.

8.3.3 Monthly

An Environmental Report is submitted monthly. It is a checklist report to be sure required inspections and reports have been done. The report is contained in the Environmental Manual, Section XXII.

Each facility must inspect the safety equipment at the facility and submit a written report. The requirements for this report are contained in the Safety Manual, Section SF VII. Safety equipment is also examined on a monthly basis to ensure that it is operating properly. All hand-held fire extinguishers are checked on a monthly basis to ensure that they are functioning properly. In addition, safety showers are examined monthly to ensure proper operation condition.

8.3.4 Periodic

Whenever a facility wants to add a product or change an existing product a written New Product Checklists must be submitted for review and approval. The requirements for this report are contained in the Environmental Manual, Section XXVI.

8.3.5 Corporate Staff

The Corporate Staff reviews the documents as submitted. Members of the Corporate Staff also conduct both announced and unannounced on-site reviews of various disciplines.

8.4 Periodic Physicals

Periodic physicals (i.e., annual or biannual), are available for designated employees dependent on specific job functions and responsibilities (i.e., emergency response team members and drivers).

8.5 Other

To the extent allowed by law, the company requires pre-employment drug screening and random drug testing after employment.

SECTION 9
TRAINING

9.0 Training

Employee training is a prime requisite for safe operations and an effective release prevention program. A formal program has been established to facilitate training. This program consists of:

A Safety Manual that discusses and explains policies and procedures

A Safety Training Manual that provides details on the various training and instructional programs that have been established for all employees.

Monthly Safety Training Meetings;

Safety awareness displays and bulletin board postings;

Safety department communications;

Safety videos;

Written Training Records;

Accident information;

Drills; and

Other resources.

Other avenues of communication have been developed that review current injury statistics and discusses trends that exist, as well as setting the direction for the facility.

9.1 Overview

Ongoing communication of health and safety matters ensures that all personnel are properly trained. All facility personnel, including office and sales personnel, drivers, and plant employees, receive training. Depending upon the topic, the training is usually conducted annually. Training is documented on the employee's Record of Training (JCI Safety Training Manual, Chapter I).

The primary employee training program can be broken down into three phases:

1. New employee indoctrination;
2. Job instruction and training; and
3. Periodic training.

A description of the primary personnel training programs provided by JCI under each of these three phases is provided below.

9.1.1 New Employee Indoctrination

Training for new employees is a combination of classroom and activity-specific on-the-job training. Training is completed when the new employee demonstrates competency in the new job to the Branch Manager, Plant Manager, and Foreman.

New employee indoctrination is the orientation of a new employee to the JCI Corporate Health and Safety policies and procedures, before they begin work. <u>ALL</u> new employees are trained in the following, including but not limited to the following:

Corporate safety policy

General safety rules

Plant safety rules

Eye, face, and head protection policy

Respiratory protection policy

Safety shoe policy

Visitor policy, smoking policy

JCI's Hazard Communication Training program

Fire prevention policy

Accident prevention program

Instructions on hazardous materials handling

Facility emergency evacuation plan and contingency plan; and

Proper use and maintenance of personal protective equipment.

A safety training form is signed and dated by the new employee to indicate that specific topics have been covered and understood. The new employee then goes through respiratory protection training and is fitted for a respirator (if required by his or her job duties). Lastly, the new employee is supplied with personal protective equipment including approved safety glasses or goggles, bump cap (optional), and an escape respirator. Safety shoes are also required.

9.1.2 Job Instruction Training

Since hazardous materials are handled at the facility, training in procedures specific to the plant employee's job position is critical to safety. Therefore, all new plant employees must learn all job specific procedures before they are allowed to work without direct supervision. At JCI, a technique called Job Instruction Training (JIT) is used to provide on-the-job training in specific tasks. It is a simple procedure for training employees (either new hires, transferred employees, or old hands).

Provide a mechanism to help employees to perform their jobs safely and efficiently

Provide consistent, uniform operations

Shorten the learning time

Minimize the likelihood of injuries, property damage, spills. leaks, and releases

During job instruction, the employee is first shown the job in detail and the quality standards that must be met. Next, the trainer performs the job functions along with the employee being trained. This enables the trainee to see the work being performed exactly as they will do it on the job. The last step is to allow the trainee to perform the job in a trial performance. At this point in the instruction cycle, the trainer becomes a coach and watches the trainee perform. This is continued until the trainee has mastered the job.

The Branch Manager or his designee is responsible for providing the required JIT.

9.1.3 Periodic Training

In addition to safety training received as a new hire, all employees are required to attend periodic safety training relative to their job position. The purpose of periodic safety training is to update employees in changes in processes, new information, regulations, etc. Periodic safety training is also provided when an employee is assigned to a different job or requires additional training in his/her present job. Periodic safety training includes refresher training conducted annually.

Refresher training consists of reinforcing the safety training an employee has previously received. This training is necessary when: an employee returns to a job he/she previously learned, employee performance needs to be improved, a new product is handled at the plant, or new equipment or processes are installed. Refresher training is also provided when an employee is assigned to a different job.

The purpose of annual training is to update employees on changes in processes, training information, regulations, etc. and to reinforce the proper method to perform a specific job. Certain training must be completed annually, as required by law (e.g., OSHA, DOT, etc.). The training required depends on the employee's job position.

9.2 Equipment Operations and Maintenance Training

All plant operators and maintenance personnel are trained in the general procedures for operation and maintenance of all plant equipment. In addition, each employee receives further specialized training in their specific job responsibilities. Each employee is required to undergo a training program for each piece of equipment or system that he/she is responsible for operating or maintaining. Training is conducted by either the Branch Manager or his/her designee on plant standard operating procedures (SOPs) and specific equipment operating or maintenance procedures. Employees go through job instruction training under the supervision of either the Branch Manager or his/her designee. For each of the equipment training programs, the employee must show proficiency in a number of items through any and all performance testing before he is allowed to operate or perform maintenance on a particular piece of equipment. Once an employee has completed the proficiency testing and training requirements for the tasks of a specific job operation, the trainer observes the employee performing the tasks. If the employee performs to his satisfaction, the trainer signs off on the training record and transfers it to the employee's personnel file. The Employee Record of Training is contained in the JCI Safety Training Manual, Chapter I.

9.3 Emergency Response Training

All members of the facility Emergency Response Team have gone through an initial 24-hour emergency response training class. The initial training course included instruction in operation of all fire protection and fire fighting equipment, release control and containment procedures, personal protective clothing, plant and agency emergency notification procedures, and evacuation procedures. In addition, all employees have been familiarized with the Plant's Contingency Plan. All members of the emergency Response Team are required to complete an 8-hour annual refresher course on emergency response training and will be tested on their knowledge and understanding of the Plant's Contingency Plan. It is recommended that emergency response training drills be held on a periodic basis to maintain proficiency. Following the drill, a meeting will be held to critique the emergency response procedures performed during the drill and to identify any portions of the drill or other topics and procedures that should be modified in light of the information obtained during the drill.

Employees may be asked to perform accident rescue operations using self-contained breathing apparatus (SCBA) and other personal protective equipment. The purpose of these drills is to continually reduce rescue times and familiarize employees with use of the self-contained breathing apparatus.

9.4 Environmental Compliance, Reporting and Record Keeping Procedure Training

All plant personnel receive instruction on regulatory compliance requirements. Personnel will be instructed in their respective responsibilities for waste water discharge and monitoring, proper hazardous waste disposal requirements and record keeping procedures, and required regulatory agency reports for hazardous substance spills and releases, and waste water discharges and monitoring. Personnel will also be instructed on proper filing and documentation procedures for all regulatory related correspondence, reports, and permits.

SECTION 10
EMERGENCY RESPONSE

10.0 Emergency Response

The facility has a trained emergency response team, and appropriate equipment and supplies. The equipment includes a recovery vessel ("coffin") to contain a leaking 150-pound chlorine or sulfur dioxide cylinder, and Chlorine Institute approved A-Kits, B-Kits, and C-Kits to contain a leaking 150-pound, 2000-pound or 90-ton container respectively of chlorine or sulfur dioxide.

10.1 Facility Emergency Response Plan

The facility has a detailed Contingency Plan based on corporate guidelines and facility specific information. The Contingency Plan outlines the procedures to be taken in the event of an accidental release of either liquids or gases and specifies notification, evacuation, and release control and containment measures for accidental releases that may occur at the plant or on the highway (in transportation accidents). Review of the plan is conducted at the facility's monthly safety meetings. The Branch Manager is responsible for updating the Contingency Plan. Any amendments to the Contingency Plan must be approved by the JCI Corporate Office prior to implementation.

The Contingency Plan provides a listing of all employees and their respective job descriptions. A primary emergency coordinator and an alternate coordinator are designated in the plan. A minimum of four (4) employees are designated emergency responders. The home telephone numbers and addresses of the primary and alternate coordinators are also included. The emergency coordinator is in charge during release incidents and is given the authority to commit the resources necessary to implement the plan. The emergency coordinator is responsible for warning all plant employees of the emergency, coordinating facility procedures, and communicating with local response teams.

10.2 Emergency Response Exercises and Simulations

It is recommended that facility personnel conduct periodic emergency response training exercises each year. These exercises are discussed at the monthly safety training meeting and the critiques used to update the Contingency Plan.

10.3 Fire, Evacuation, and Rescue Corridors

A primary staging area, a secondary staging area, and evacuation routes are designated in the plan. Personnel without assigned duties and personnel that have fulfilled their emergency response duties assemble at the primary staging area. In the event the primary staging area is determined to be unsafe, the secondary staging area is used. When both areas are deemed unsafe, the emergency coordinator designates an area for personnel to assemble.

The facility has established evacuation procedures as outlined in the Contingency Plan. The corridors leading to the exits are kept free of obstructions. During evacuation, personnel meet at the designated staging area. An employee is designated to muster personnel in the Contingency Plan and is responsible for ensuring that all employees, visitors, and contractors on-site are accounted for.

10.4 Emergency Equipment Provisions

The facility maintains the majority of its emergency response equipment in the western end of the warehouse just outside the breakroom. There are 4 self contained breathing apparatuses (SCBAs), 4 fully encapsulating suits, 1 Chlorine Institute "A" kits for cylinders, 1 Chlorine Institute "B" kits for ton containers, 1 Chlorine Institute "C" kit for tank cars, and 1 chlorine recovery vessel.

Caustic soda and soda ash are stored in the warehouse to absorb and neutralize spills. In addition, hand held fire extinguishers are located throughout the facility.

Fire extinguishers, gas masks, eyewash, and shower stations are located throughout the facility. Employees are required to wear safety glasses, bump caps (optional), and steel-toe shoes, and carry escape respirators. Caustic soda and soda ash are stored in the warehouse.

Safety equipment is inspected monthly. Training on the use of the equipment is provided by the manufacturers, by means of videotapes, by written lesson plans, and/or by drills.

10.5 Emergency Response Chain of Authority

The designated emergency coordinator is in charge during emergency situations. Authority is relinquished to the local fire department upon their arrival. The emergency coordinator assists the response effort as requested.

10.6 Emergency Response Management Procedures

The emergency coordinator position is held by a member of facility management. The emergency coordinator is responsible for all actions taken to mitigate an emergency until local response agencies arrive.

10.7 Emergency Communication Notification Within the Facility

See Section 6 - Detection and Monitoring, and the facility's Contingency Plan.

10.8 Emergency Response Personnel Training Requirements

Facility personnel receive at least 24 hours of initial, in-house emergency response training, as well as at least 8 hours of annual refresher training.

10.9 Follow-up Release Procedures

In most release cases, assigned facility personnel do the clean-up activities. The JCI Corporate Office may also employ an outside environmental cleanup agency for use in the cleanup of a major release should one occur. Following a release, a full plant, in-house critique is performed.

10.10 Previous Incidents Involving HHC

The five-year accident history for this facility is contained in the facility's Risk Management Plan Manual.

SECTION 11
HAZARD and OPERABILITY STUDY (HazOp)

11.0 Introduction

This section documents the results of the Hazard and Operability Study for the Process Hazard Analysis (PHA) for the JCI facility located at 16248 Industrial Drive Milford, Virginia 22514.

On April 13,2009 a Process Hazard Analysis (PHA) meeting was held at the JCI facility located at 16248 Industrial Drive, Milford. Virginia 22514 ("the facility"). Present were the following JCI employees:

Mike Washington-Branch Manager	Jeremiah Dawson-Operator
James Wright-Plant Manager	Gary Kohr-Maintenance

The PHA meeting included a brief training session was held to discuss PHA technique to be used. A brief facility tour was conducted to verify the generic process flow diagram (including all flow control valves and pressure gauges) for each handling system. Informal discussions with several plant operators regarding operating procedures, emergency response procedures, facility evacuation plan, emergency staging areas, alternate staging areas, and general level of experience at the facility were also held. A facilitated discussion in the facility's conference room followed the tour.

11.1 – Background

11.1.1 – Description of the "What If?" Process Hazard Analysis Technique

The concept of a "What If?" analysis is to conduct a thorough and systematic examination of the process or operation under review by asking questions that begin with "What If...". The examination can include buildings, power systems, raw materials, products, storage, materials handling, in-plant environment, operating procedures, work practices, management practices, plant security, and other pertinent parts of plant operations. While in the process of conducting the "What If" analysis, it is important to consider the "human factors" associated with each process, event, and/or function being reviewed and specifically the relationship between our employees and each process event and/or function. The formulation of the exact questions is left up to those individuals conducting the process hazard analysis, unless questions have been formulated during a previous process hazard analysis. The intent of this analysis is to reduce any potential risks identified if possible by modifying either operating procedures and/or equipment.

The questioning usually starts at the input to the process and follows the flow of the process to the output. Alternatively, the questioning can center on a particular consequence category (e.g., personnel safety, public safety, etc.). Usually, a small group of two to three individuals conducts the examination and reports the findings. In general, the findings consist of accident event sequences that result from the "What If?" questions. The questions essentially suggest an initiating event, and perhaps a failure from which an undesirable event sequence could occur. For example, a typical "What If" question might be: "What if the raw material is the wrong concentration?"

The process hazard analysis team would then attempt to determine how the process being evaluated would respond.

11.1.1.1 - Guidelines for Using the "What If?" Process Hazard Analysis Technique

The "What If" process hazard analysis technique includes the following steps:

Define the study boundaries.
Gather the needed information.
Define the process hazard analysis team.
Conduct the process hazard analysis (process review).
Develop recommendations.
Record the results.

Each of these steps is discussed below.

11.1.1.2 - Define the Study Boundaries

There are two types of study boundaries in a "What If?" study: the physical system boundaries and the consequence category being evaluated. These two boundaries are closely related. That is, the consequences to be evaluated will define what portions of the plant to consider in the evaluation (process hazard analysis).

After the consequence category has been defined, the physical boundaries of the study can be defined. The purpose of defining the physical boundaries of the process hazard analysis is to keep the process hazard analysis team focused on portions of the facility in which the consequence of concern could occur. Care must be taken in defining these boundaries because very often there are interactions between parts of a plant, some of which may not be hazardous in and of themselves (relative to the consequence being considered) but which may cause some other portion of the plant to perform abnormally and hence result in an accident event sequence.

The physical boundaries of the "What If?" analyses were defined as each of the sources of chemicals of concern within the boundaries of the facility. Thus, each "system" was defined as all steps/activities involving a chemical to be studied from the point at which it is received at the facility to the point at which repackaged containers containing that chemical is loaded onto delivery trucks and shipped off-site.

11.1.1.3 - Gather the Needed Information

It is important that all critical information be available to the team during the process hazard analysis to allow the evaluation process to continue unhindered. Therefore, after the study boundaries have been defined, information needed to perform the process hazard analysis is gathered and reviewed. For JCI, the information included the following:

- facility site layout and plot plan and regional topographic map;
- standard operating procedures including those for the chemicals to be studied which are contained in the Production Manual;
- standard maintenance procedures, preventive maintenance procedures, and inspection procedures which are contained in the Maintenance Manual;
- site review procedures which are contained in the Environmental Manual;
- operator training procedures which are contained in the Safety Training Manual;
- health and safety procedures and OSHA process safety management compliance program which are contained in the Safety Manual and Safety Training Manual;
- OSHA hazard communication program which are contained in the Safety Training Manual;
- emergency response procedures contained in the facility business plan and the facility Contingency Plan Manual, Safety Manual, Safety Training Manual, and Environmental Manual.
- facility equipment and specifications which are contained in the Engineering I and Engineering II Manuals;
- site security plan contained in the Security Manual;

- facility transportation that is contained in the Transportation Manual and the Environmental Compliance Manual.

This information was then evaluated and utilized to formulate a preliminary listing of "What If" questions to be addressed during the process hazard analysis.

11.2 - Process Hazard Analysis

The HHCs handled at the facility are chlorine (Cl_2) and sulfur dioxide (SO_2).

Chlorine is brought on site in bulk quantities and repackaged into smaller containers for distribution to customers. In addition, chlorine is used in the manufacture of sodium hypochlorite (bleach). Sulfur dioxide is brought on site already repackaged and subsequently distributed to customers by truck.

The HHC's, respective TQ's, and maximum amount in inventory at this facility are listed in the table below.

HHC	TQ	Maximum Inventory
Chlorine	1,500 pounds	360,000
Sulfur dioxide	1,000 pounds	24,000

In general, the amount of a particular HHC present on site at any specific time will exceed its respective TQ.

A generic "What If" analysis technique for hazards analysis was selected because of the "non-complex" nature of operations involving the HHC's handled at JCI's facilities; the low experience level in hazards analysis of the JCI's personnel; and because the PHA technique has been successfully applied to evaluate the HHC processes at the facility in the past.

The "What if" questions for the HHC's and their respective processes at this facility are listed below.

11.2.1 - Chlorine Process

11.2.1.1 - Chlorine Repackaging

What If?

- Rail car has a transportation accident with facility traffic (e.g. forklift, vehicles, etc.).
- Rail car has a transportation accident with another rail car on the spur during docking or spotting.
- A rail car is delivered with or develops a liquid phase pinhole leak.
- A rail car is delivered with or develops a vapor phase pinhole leak.
- Rail car develops a slow leak in liquid phase due to an external event.
- Rail car develops a slow leak in vapor phase due to an external event.
- Railcar has a catastrophic failure.
- The wrong rail car is connected to the system.
- Rail car is over pressurized.
- Failure of main rail car valve.
- Failure of transfer piping or transfer piping valves at various points in the system.
- System barometric loop fails.
- Filling station valve(s) fail.
- Filling station liquid blow down lines/vacuum lines or blow down ton containers fail or overfill.
- Filling station operator fills wrong container.
- The container is not empty prior to filling. It contains water or another chemical.
- Filling station operator overfills container.
- Catastrophic failure of one-ton container.
- Catastrophic failure of 150-pound cylinder.
- Filling station operator fills a leaking 150-pound cylinder.
- Filling station operator fills a leaking one-ton container.
- Filling station operator is filling containers during inclement weather (e.g., rain, high winds, etc.).
- Accident during storage or transfer of filled containers resulting in the container valve being knocked off.
- Fire in storage area or near fill stations.
- Water in chlorine air pad system.
- Disgruntled employee commits sabotage.
- Vacuum system failure.
- Mitigation system failure.
- Sensor failure.
- Spare sensor parts are not available.
- Sensor is improperly set.

- CL2 lines are not properly identified.
- Eye wash station is not available.
- Improper tools are used.
- CL2 alarm sounds and there is no leak.
- Emergency equipment is not properly located.
- Fire Department can't respond.
- Systems are not inspected regularly.
- PPE fails.
- Pipe hangers fail.
- Employees are not trained properly.
- Changes are not communicated to employees.

11.2.1.2 – Chlorine Storage and Distribution

What If?

- Delivery vehicle, in bound or out bound, has a transportation accident with facility traffic (e.g., rail cars, forklifts, etc.).
- A container is received with a liquid phase pinhole leak.
- A container is received with a vapor phase pinhole leak.
- Container develops a slow leak in liquid or vapor phase while in storage.
- Catastrophic failure of a one-ton container.
- Catastrophic failure of a 150-pound cylinder.
- Container develops a slow leak in liquid or vapor phase due to an external event.
- Container develops a catastrophic leak in liquid or vapor phase due to an external event.
- Container overfilled by supplier.
- Accident during transfer to storage or while in storage of filled containers resulting in the container valve being knocked off.
- Accident during loading or unloading.
- Fire in storage area.
- Disgruntled employee commits sabotage.

11.2.2 – Sulfur Dioxide Process

11.2.2.1 – Sulfur Dioxide Storage and Distribution

What If?

- Delivery vehicle, in bound or out bound, has a Transportation accident with facility traffic (e.g., Railcars, forklifts, etc.).
- A container is delivered with a liquid phase pinhole leak.
- A container is delivered with a vapor phase pinhole leak.
- Container develops a slow leak in liquid or vapor phase While in storage.
- Catastrophic failure of one-ton container.
- Catastrophic failure of 150-pound cylinder.
- Accident during storage or transfer of filled containers resulting in the container valve being knocked off.
- Fire in storage area.
- Container develops a slow leak in liquid or vapor phase due to an external event.
- Container develops a catastrophic leak in liquid or vapor phase due to an external event.
- Container overfilled by supplier.
- Accident during loading or unloading.
- Disgruntled employee commits sabotage.
- Vacuum system failure.
- Mitigation system failure.
- Sensor failure.
- Spare sensor parts are not available.
- Sensor is improperly set.
- Eye wash station is not available.
- Improper tools are used.
- SO2 alarm sounds and there is no leak.
- Emergency equipment is not properly located.
- Fire Department can't respond.
- Systems are not inspected regularly.
- PPE fails.
- Pipe hangers fail.
- Employees are not trained properly.
- Changes are not communicated to employees.

11.2.3 – Sodium Hypochlorite Manufacturing Process

11.2.3.2 – Make Vats

What If?

- There is a leak from the chlorine supply piping.
- The sodium hypochlorite make vats are over-chlorinated.
- There is a low-level event in the sodium hypochlorite make vats that exposes the chlorine supply pipe.
- Sodium hypochlorite leaks from make vats, transfer lines, or storage tanks.
- The pipes or vessels overheat.
- The system over pressurizes.
- There is a power failure.
- Human error occurs.

11.2.4 - Developing Scenarios

The questions listed above were entered on a form and numbered. Responses to the "What if" questions (the consequence) and recommendations were developed. Each "What if" question, its consequence, and recommendation are a scenario. Each scenario is identified by a numeric notation corresponding to the question number. This allows tracking of each scenario recommendation. It also allows ranking and screening by a matrix to achieve qualitative analysis based on likelihood of occurrence and severity. The results are contained in Section 12.

SECTION 12
RESULTS OF THE WHAT IF HAZARDS ANALYSIS

12.0 Results

The following tables contain the results of the "What if" process hazard analysis for the HHCs at the facility.

TABLE 12.a.1 - Results of the "What If?" Process Hazard Analysis for the Chlorine Repackaging System

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
1. Rail car has a transportation accident with facility traffic (e.g., forklifts, vehicles, etc.).	There could be a release of anywhere from less than one-pound to 90-tons of chlorine. Under a major or catastrophic release the JCI Emergency Response Procedures (ERP) would be initiated. The plume direction would be noted and reported to 911. Next, the facility Emergency Response Coordinator(s) would initiate plant evacuation.	None. This scenario is extremely unlikely since rail car docking area is off limits to facility traffic. Rail cars rarely cross the roadway coming into the site. In addition, there is a 5-MPH speed limit for facility traffic.	3A
2. Rail car has a transportation accident with another rail car on the spur during docking or spotting.	There could be a release of anywhere from less than one-pound to 90-tons of chlorine. Under a major or catastrophic release the JCI Emergency Response Procedures (ERP) would be initiated. The plume direction would be noted and reported to 911. Next, the facility Emergency Response Coordinator(s) would initiate plant evacuation.	None. Procedures are in place between JCI and the servicing railroad conducting the switch to prevent this scenario, and it is extremely unlikely.	3A
3. A rail car is delivered with or develops a liquid phase pinhole leak.	JCI personnel would expedite unloading of the rail car into containers. Unloading a full rail car into containers could require 24 hours or more. Another possibility is to unload the rail car into an empty rail car if one is available which would require less time, or apply a C-Kit if appropriate. Depending on the size of the leak the release could be significant, but most likely not the entire contents of the railcar.	None. This scenario would be extremely unlikely as all rail cars are regulated by DOT and inspected regularly.	2A
4. A rail car is delivered with or develops a vapor phase pinhole leak.	See Item 3 above.	None. This scenario would be extremely unlikely as all rail cars are regulated by DOT and inspected regularly.	2A
5. Rail car develops a slow leak in liquid phase due to an external event.	Depending on the size of the leak the release could be significant, but most likely not the entire contents of the railcar. Under a major or catastrophic release the JCI Emergency Response Procedures (ERP) would be initiated. The plume direction would be noted and reported to 911. Next the facility Emergency Response Coordinators would initiate plant evacuation.	None. This scenario is considered highly unlikely.	2A

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
6. Rail car develops a slow leak in vapor phase due to an external event.	Depending on the size of the leak the release could be significant, but most likely not the entire contents of the railcar. Under a major or catastrophic release the JCI Emergency Response Procedures (ERP) would be initiated. The plume direction would be noted and reported to 911. Next the facility Emergency Response Coordinators would initiate plant evacuation.	None. This scenario is considered highly unlikely.	2A
7. Rail car has a catastrophic failure.	Under a major or catastrophic release the JCI Emergency Response Procedures (ERP) would be initiated. The plume direction would be noted and reported to 911. Next the facility Emergency Response Coordinators would initiate plant evacuation.	Determine how the facility will notify local residents and/or businesses in the immediate vicinity of the branch in the event of a catastrophic failure of a railcar.	3A
8. The wrong rail car is connected to the system.	A cross-contamination in process piping and the system could occur, resulting in a minor vapor release at the make vat.	None. This scenario is considered highly unlikely. Chlorine cars are identified by placards and stenciled name. Receiving reports must be prepared for each rail car. See Item 3 above.	1A
9. Rail car is over pressurized.	Under extremely high pressures, the rail car valve could burst resulting in an uncontrolled release of chlorine. However, the entire contents of the rail car could be vented through the relief valve.	None. The compressor has a maximum pressure of approximately 180 psi and is inspected daily as part of our mechanical integrity program. The railcar has a relief valve with a set point of 350 psi.	2A
10. Failure of main rail car valve.	Unrestricted flow of chlorine - up to 90 tons. Each car has an excess flow valve (ball valve) between the main valve and the contents of the car. The valve would automatically stop flow. If the excess flow valve failed, there could be unrestricted flow of chlorine. If the leak was minor, JCI personnel would don personal protective equipment and attempt to mitigate the release by applying a C-Kit to the valve. The plume direction would be noted and reported to 911. Next, the facility Emergency Response Coordinators would initiate plant evacuation. The rail car would be sent back to the manufacturer.	None. The valve is never opened without being connected to a closed system.	3A
11. Failure of transfer piping or transfer piping valves at various points in the system.	Depending upon the location of the leak and the amount of chlorine remaining in the rail car, there could be a release of up to 90 tons of chlorine. If the	None. This is considered to be highly unlikely given the leak prevention, mitigation systems, and inspection procedures in place.	2B

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
	up to 90 tons of chlorine. If the failure is in the piping, a JCI operator would isolate the leaking section by closing the valves around the point of the leak and initiating repairs. All chlorine piping runs are contiguous and are labeled for contents and direction of flow. The largest section of piping between flow control valves is approximately 20 feet and expansion chambers are installed in all piping runs of 100 feet or more. The potential for leaks due to corrosion is limited since the corrosion rate is slow for dry chlorine and the piping undergoes rigorous preventive maintenance procedures.		
12. System barometric loop fails.	This may result in the release of a minor amount of chlorine gas.	None. This is considered to be highly unlikely given the leak prevention, mitigation systems, and inspection procedures in place.	1A
13. Filling station valve(s) fail.	This could be of minimal consequence during a filling operation because leak detectors located throughout the process area would trigger warning alarms and automatic shutdown at pre-established settings. Plant Emergency Stops (E-Stops) are also positioned throughout the process area. Audible alarms are installed in easily accessible areas at the filling stations.	None. This is considered to be highly unlikely given the leak prevention, mitigation systems, and inspection procedures in place.	1C
14. Filling station liquid blow down lines/vacuum lines or blow down ton containers fail or overfill.	Normally there is a very small amount of chlorine in the vacuum or blow down container. Failure could result in the release of the entire contents of the traps (up to 2000 pounds). If additional chlorine is added, the excess will flow into the bleach vats eventually triggering the ORP alarm. Loss of vacuum would trigger the vacuum alarm. In the case of overfilling, a problem will occur	None. Alarm will activate if vacuum fails.	1B

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
	only if the discharge valve on the surge ton is closed, thereby preventing the transfer of chlorine to the blow vat(s).		
15. Filling station operator fills wrong container.	The container would be filled with the wrong gas and would have to be emptied. No release would be expected.	None. This scenario is highly unlikely because the containers are differentiated by color coding and stenciling. In addition, supervisors are constantly overseeing the operations.	1B
16. The container is not empty prior to filling. It contains water or another chemical.	The chemicals would mix in the container. No reaction or release would be expected.	None. This scenario is highly unlikely because all containers are emptied, a vacuum pulled, a cylinder valve or ton container fuse plug removed, the interior inspected, and the valve or fuse plug replaced before the container arrives at the filling station. In addition, supervisors are constantly overseeing the operations.	1A
17. Filling station operator overfills container.	Minor overfilling is possible. If the container's target fill weight is exceeded, the system would be automatically shut off and the excess chlorine would be bled off into the vats.	Overfilling a ton container is highly unlikely given that the filling systems are equipped with automatic shutoffs designed to activate at predetermined set points. All containers are filled according to weight. In addition, each scale is checked daily using a container of known weight and the scales are calibrated on an annual basis. Review procedures to ensure that the potential for overfilling of 150 pound cylinders is properly addressed and that all cylinder fill stations have automatic shutoffs.	1A
18. Catastrophic failure of a one-ton container.	A catastrophic failure of a ton container could occur resulting in the instantaneous release of up to 2000 pounds of chlorine.	None. This is considered highly unlikely because the containers undergo thorough hydrostatic testing and inspection procedures (these containers are regulated by DOT).	3A
19. Catastrophic failure of a 150-pound cylinder.	A catastrophic failure of a cylinder could occur resulting in the instantaneous release of up to 150 pounds of chlorine.	None. See Item 18.	3A
20. Filling station operator fills a leaking 150-pound cylinder.	An operator will not knowingly fill a leaking 150-point cylinder, however, if a leak does occur and is discovered at the station, the system would be shut off and the leaking cylinder's contents would be evacuated. If the leak developed at a later time, the cylinder would be	None.	2A

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
	positioned to avoid a liquid phase release by standing it upright, etc. JCI personnel would then don personal protective equipment and attempt to mitigate the release by utilizing an A-kit or recovery vessel. Once this is accomplished, the cylinder contents would be evacuated. The facility has a 150-pound cylinder recovery vessel. A leaking cylinder would be enclosed in the recovery vessel and the vessel bled of its contents. Due to its potential effectiveness in reducing the hazards associated with leaking 150-pound cylinders, all personnel receive thorough training in its use.		
21. Filling station operator fills a leaking one-ton container.	See Item 20 above, except no recovery vessel. Seal with B-kit.	None.	2A
22. Filling station operator is filling containers during inclement weather (e.g., rain, high winds, etc.).	The filling station is indoors. In the case of extremely violent weather (i.e., hurricane, tornado, etc.), a decision will be made as to whether filling operations will continue.	None.	1A
23. Accident during storage or transfer of filled containers resulting in the container valve being "knocked off".	This type of situation would be handled in a manner similar to that of Item 18 and 19 above. For one-ton containers, the fuse plugs could fail, resulting in the release of the entire contents of the container (one ton). A container would be rotated to move the leak point to the vapor side to lessen the rate of release.	None. A valve being knocked off after filling would be highly unlikely since valves on both one-ton and 150-lb containers are covered with a protective covering and due to the concave nature of the ends of one-ton containers (in addition to valve coverings). Forklifts would be the main plant vehicular traffic that would pose the risk of knocking off a valve. Thus, clear lanes for forklift travel have been established. This, in conjunction with marked storage areas reduces the likelihood of this scenario.	3A
24. Fire in storage area or near fill stations.	Container fuse plugs could fail resulting in the release of the entire contents of the container.	None. No flammables are stored in the vicinity of the fill stations. In addition, ABC Chemical fire extinguishers are located throughout the area.	3A
25. Water in chlorine air pad system.	Excessive moisture can cause plugging of the chlorine process lines.	None. The air padding system has a drier installed to prevent the inadvertent introduction of water into the system. Moisture content in the air is monitored daily. Increased pressure will only cause production issues.	1A

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
26. Disgruntled employee commits sabotage.	An act of sabotage could result in the release of a large amount of chlorine.	None. In accordance with JCI's Security Plan, walk-through inspections of the facility are conducted daily and security awareness among all employees is a top priority.	3A
27. Vacuum system failure.	Low vacuum alarm would activate. Filling would halt until remedial measures are taken.	None.	1A
28. Mitigation system failure.	Continued release of product due to mitigation system not automatically activating.	None. This scenario is considered highly unlikely as all mitigation systems are checked daily. In addition, manual shutdown procedures would be activated.	2A
29. Sensor failure.	Since there are multiple sensors strategically located throughout the facility, it is highly unlikely that they would all fail at the same time. As such, if a single sensor were to fail, a minor release could occur until another sensor picked up the release, or until the manual shutdown button was activated.	None. This scenario is considered highly unlikely since the sensors are checked daily, and a span calibration test is conducted every 90 days.	1A
30. Spare sensor parts are not available.	Since there are multiple sensors strategically located throughout the facility, it is highly unlikely that they would all fail at the same time in which case new parts would have to be ordered and replaced. As such, if a single sensor were to fail and had to be replaced, a minor release could occur until another sensor picked up the release, or until the manual shutdown button was activated.	None. Parts can be ordered immediately and can usually be shipped with a day or two. Until then, the area without the sensor would be more closely watched by human means.	1A
31. Sensor is improperly set.	Since there are multiple sensors strategically located throughout the facility, it is highly unlikely that they would all be improperly set at the same time. As such, if a single sensor were improperly set, a minor release could occur until another sensor picked up the release, or until the manual shutdown button was activated.	None. This scenario is considered highly unlikely since the sensors are checked daily, and a span calibration test is conducted every 90 days.	1A
32. CL2 lines are not properly identified.	None. Our chlorine and sulfur dioxide repackaging systems are separate and they are properly identified by marking and color-coding.	None.	1A
33. Eye wash station is not available.	Since there are multiple eye wash stations strategically located throughout the facility, it is highly unlikely that they would all not be available. As	None. This scenario is considered highly unlikely since the eye wash stations are readily available and are checked for operability every day.	1A

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
	such, if a single eye wash station was not available, an employee who was exposed to a chemical could be exposed slightly longer until he reached another eye wash station.		
34. Improper tools are used.	None, since JCI does not use any improper tools in its repackaging operations.	None.	1A
35. CL2 alarm sounds and there is no leak.	None, since this would simply indicate equipment malfunction, in which case the equipment would be immediately repaired. No release of product would be expected.	None.	1A
36. Emergency equipment is not properly located.	None, since all emergency response equipment is stored in a dedicated area.	None.	1A
37. Fire Department can't respond.	No immediate consequences as JCI's emergency response team would perform the emergency response.	None.	1A
38. Systems are not inspected regularly.	None, since JCI has an in-depth Mechanical Integrity and Preventative Maintenance program in which all systems, operations, equipment, etc. are inspected on either a daily, weekly, monthly, quarterly, and or etc. basis as directed.	None.	1A
39. PPE fails	An employee could be exposed to a chemical.	None. This scenario is considered highly unlikely since all PPE is inspected on a regular basis.	3A
40. Pipe hangers fail.	Since there are multiple pipe hangers supporting each piece of pipe, it is highly unlikely that they would all fail at the same time. Even if one pipe hanger were to fail, it is highly unlikely that anything would happen.	None.	1A
41. Employees are not trained properly.	None, since JCI has an in-depth employee safety training program, and no one is allowed to work in our compressed gas operations unless they are thoroughly trained in all aspects of the compressed gas operations.	None.	1A
42. Changes are not communicated to employees.	None, since JCI has formal Management of Change, Pre-Startup Safety Review, Employee Safety Training, and Employee Participation programs under OSHA's PSM program, and all changes are promptly communicated to all employees.	None.	1A

TABLE 12.a.2 - Results of the "What If?" Process Hazard Analysis for the Chlorine Storage/Distribution System

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
1. Delivery vehicle, in bound or out bound, has a transportation accident with facility traffic (e.g., rail cars, forklifts, vehicles, etc.).	There could be a release of anywhere from less than one pound to one ton of chlorine. JCI personnel would don personal protective equipment and attempt to mitigate the release. Under a major or catastrophic release, the JCI Emergency Response Procedures (ERP) would be initiated. The plume direction would be noted and reported to 911. Next, the facility Emergency Response Coordinator(s) would initiate plant evacuation.	None. This scenario is unlikely since there is a 5-MPH speed limit for facility traffic.	3A
2. A container is received with a liquid phase pinhole leak.	Depending on the size of the container and of the leak, there could be a release of anywhere from less then one pound to one ton of chlorine. JCI personnel would don personal protective equipment and attempt to mitigate the release using the appropriate repair kit. If the container was still on the delivery vehicle, JCI personnel would unload the container from the delivery vehicle. If the container had already been unloaded, they would position the container to avoid a liquid phase release by (standing it upright, rotating leak to top, etc.), and utilize the appropriate emergency kit. Once this is accomplished, the cylinder contents would be evacuated by using it on site, transferring to another container that is under vacuum, or by neutralizing the gas with an aqueous solution of sodium hydroxide (caustic soda).	None. This scenario would be extremely unlikely as all containers are regulated by DOT and inspected regularly.	2A
3. A container is received with a vapor phase pinhole leak.	See Item 2 above.	None. This scenario is considered highly unlikely. See Item 2 above.	2A
4. Container develops a slow leak in liquid or vapor phase while in storage.	See Item 2 above.	None. This scenario is considered highly unlikely. See Item 2 above.	2A
5. Catastrophic failure of a one-ton container.	See Item 1 above. Release quantity could be up to one ton.	None. This scenario is considered highly unlikely. See Item 2 above.	3A
6. Catastrophic failure of a 150-pound	See Item 1 above. Release quantity could be up to 150 pounds.	None. This scenario is considered highly unlikely. See Item 2 above.	3A

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
cylinder.			
7. Container develops a slow leak in liquid or vapor phase due to an external event.	See Item 2 above and External Event Analysis table below.	None. This scenario is considered highly unlikely. See External Events Analysis table below.	2A
8. Container develops a catastrophic leak in liquid or vapor phase due to an external event.	There could be a release of anywhere from less than one pound to one ton of chlorine. JCI personnel would don personal protective equipment and attempt to mitigate the release. Under a major or catastrophic release, the JCI Emergency Response Procedures (ERP) would be initiated. The plume direction would be noted and reported to 911. Next, the facility Emergency Response Coordinator(s) would initiate plant evacuation.	None. This scenario is considered highly unlikely. See External Events Analysis table below.	3A
9. Container over filled by supplier.	Ton containers are designed to relieve internal pressure if they become liquid full. Both ends are concave and will "bulge" to increase internal volume that relieves pressure without releasing the contents. No release would be expected.	None. Currently, JCI does not use containers filled by suppliers other than JCI. Minor overfilling is possible. Extreme overfilling is not likely. All containers are filled according to weight to less than 100 percent of liquid capacity. Thus the term "overfilling" is misleading. There is significant allowance for volumetric expansion.	2A
10. Accident during transfer to storage or while in storage of filled containers resulting in the container valve being "knocked off".	This type of situation would be handled in a manner similar to that of Item 1 above. For one-ton containers the fuse plugs could fail resulting in the release of the entire contents of the container (one ton). A container would be rotated to move the leak point to the vapor side to lessen the rate of leak.	None. A valve being knocked off after filling would be highly unlikely since valves on both one-ton and 150-pound containers are covered with a protective covering and due to the concave nature of the ends of one-ton containers (in addition to valve coverings). Forklifts would be the main plant vehicular traffic that would pose the risk of knocking off a valve. Thus, clear lanes for forklift travel have been established. This, in conjunction with marked storage areas reduces the likelihood of this scenario.	3A
11. Accident during loading or unloading.	This could result in a container striking the ground with sufficient force to cause a leak or release. See item 1 above. If the release was small, it would be handled as in item 2.	None.	3A
12. Fire in storage area.	Container fuse plugs could fail resulting the release of the entire contents of the container.	None. No flammables stored in the vicinity of stored product. In addition, ABC Chemical extinguishers are located throughout the area.	3A

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
13. Disgruntled employee commits sabotage.	An act of sabotage could result in the release of a large amount of chlorine.	None. In accordance with JCI's Security Plan, walk-through inspections of the facility are conducted daily and security awareness among all employees is a top priority.	3A

TABLE 12.a.3 - Results of the "What If?" Process Hazard Analysis for the Sulfur Dioxide Storage/Distribution System

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
1. Delivery vehicle, in bound or out bound, has a transportation accident with facility traffic (e.g., rail cars, forklifts, vehicles, etc.).	There could be a release of anywhere from less than one pound to one ton of sulfur dioxide. JCI personnel would don personal protective equipment and attempt to mitigate the release. Under a major or catastrophic release the JCI Emergency Response Procedures (ERP) would be initiated. The plume direction would be noted and reported to 911. Next, the facility Emergency Response Coordinator(s) would initiate plant evacuation.	None. This scenario is unlikely since there is a 5-MPH speed limit for facility traffic.	3A
2. A container is received with a liquid phase pinhole leak.	Depending on the size of the container and of the leak, there could be a release of anywhere from less then one pound to one ton of sulfur dioxide. JCI personnel would don personal protective equipment and attempt to mitigate the release using the appropriate repair kit. If the container was still on the delivery vehicle, JCI personnel would unload the container from the delivery vehicle. If the container had already been unloaded, they would position the container to avoid a liquid phase release by (standing it upright, rotating leak to top, etc.), and utilize the appropriate emergency kit. Once this is accomplished, the cylinder contents would be evacuated by using it on site, transferring to another container that is under vacuum, or by neutralizing the gas with an aqueous solution of sodium hydroxide (caustic soda).	None. This scenario would be extremely unlikely as all containers are regulated by DOT and inspected regularly.	2A
3. A container is received with a vapor phase pinhole leak.	See Item 2 above.	None. This scenario is considered highly unlikely. See Item 2 above.	2A
4. Container develops a slow leak in liquid or vapor phase while in storage.	See Item 2 above.	None. This scenario is considered highly unlikely. See Item 2 above.	2A
5. Catastrophic failure of a one-ton container.	See Item 1 above. Release quantity could be up to one ton.	None. This scenario is considered highly unlikely. See Item 2 above.	3A
6. Catastrophic failure	See Item 1 above. Release quantity could	None. This scenario is considered highly	3A

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
of a 150-pound cylinder.	be up to 150 pounds.	unlikely. See Item 2 above.	
7. Container develops a slow leak in liquid or vapor phase due to an external event.	See Item 2 above and External Event Analysis table below.	None. This scenario is considered highly unlikely. See External Events Analysis table below.	2A
8. Container develops a catastrophic leak in liquid or vapor phase due to an external event.	There could be a release of anywhere from less than one pound to one ton of sulfur dioxide. JCI personnel would don personal protective equipment and attempt to mitigate the release. Under a major or catastrophic release, the JCI Emergency Response Procedures (ERP) would be initiated. The plume direction would be noted and reported to 911. Next, the facility Emergency Response Coordinator(s) would initiate plant evacuation.	None. This scenario is considered highly unlikely. See External Events Analysis table below.	3A
9. Container over filled by supplier.	Ton containers are designed to relieve internal pressure if they become liquid full. Both ends are concave and will "bulge" to increase internal volume that relieves pressure without releasing the contents. No release would be expected.	None. Currently, JCI does not use containers filled by suppliers other than JCI. Minor overfilling is possible. Extreme overfilling is not likely. All containers are filled according to weight to less than 100 percent of liquid capacity. Thus the term "overfilling" is misleading. There is significant allowance for volumetric expansion.	2A
10. Accident during transfer to storage or while in storage of filled containers resulting in the container valve being "knocked off".	This type of situation would be handled in a manner similar to that of Item 1 above. For one-ton containers the fuse plugs could fail resulting in the release of the entire contents of the container (one ton). A container would be rotated to move the leak point to the vapor side to lessen the rate of leak.	None. A valve being knocked off after filling would be highly unlikely since valves on both one-ton and 150-pound containers are covered with a protective covering and due to the concave nature of the ends of one-ton containers (in addition to valve coverings). Forklifts would be the main plant vehicular traffic that would pose the risk of knocking off a valve. Thus, clear lanes for forklift travel have been established. This in conjunction with marked storage areas reduces the likelihood of this scenario.	3A
11. Accident during loading or unloading.	This could result in a container striking the ground with sufficient force to cause a leak or release. See item 1 above. If the release was small, it would be handled as in item 2.	None.	3A
12. Fire in storage area.	Container fuse plugs could fail resulting the release of the entire contents of the container.	None. No flammables are stored in the vicinity of stored product. In addition, ABC Chemical extinguishers are located	3A

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
		throughout the area.	
13. Disgruntled employee commits sabotage.	An act of sabotage could result in the release of a large amount of sulfur dioxide.	None. In accordance with JCI's Security Plan, walk-through inspections of the facility are conducted daily and security awareness among all employees is a top priority.	3A

Table 12.a.4 - Results of the "What If?" Process Hazard Analysis for the Sodium Hypochlorite Manufacturing System (Make Vats)

What If?	Consequence	Recommendation	Scenario Rank
1. There is a leak from the chlorine supply piping?	The sodium hypochlorite make vats are charged only when the plant is manned. There are chlorine sensors located throughout the plant to include in the make vat area. If a chlorine leak is detected, an audible alarm is automatically activated and automatic shutoff valves stop the flow of chlorine, isolating the railcars and any containers being filled from the piping system. The maximum release would be limited to the contents of the sodium hypochlorite make vat supply piping. This mitigation system can also be activated with manual Plant Emergency Stops (E-Stops) located throughout the plant.	None. The control and monitoring systems currently in place are considered adequate.	2A
2. The sodium hypochlorite make vats are over-chlorinated?	Over-chlorination can occur if the solution is insufficiently cooled during chlorination, or if excessive chlorine is introduced into the solution. A consequence of this type of upset is that the ORP or the temperature of the solution could increase. The sodium hypochlorite make vats are equipped with ORP and temperature sensors. If preset	None. The control and monitoring systems currently in place are considered adequate.	2A

What If?	Consequence	Recommendation	Scenario Rank
	ORP and temperature set points are exceeded, the sodium hypochlorite make vat mitigation system is automatically activated. The mitigation system automatically shuts off the flow of chlorine gas to the solution, preventing over-chlorination.		
3. There is a low-level event in the sodium hypochlorite make vats that exposes the chlorine supply pipe?	The sodium hypochlorite make vats are equipped with low-level sensors. If the level in the sodium hypochlorite make vats drops below the preset set point, an audible alarm is automatically activated. If an operator does not respond to the alarm, a release of chlorine could occur.	None. Preset low-level alarm conditions provide adequate time for an operator to respond, thereby preventing the exposure of the chlorine sparger tube and or the possibility of a pump running dry.	2A

What If?	Consequence	Recommendation	Scenario Rank
4. Sodium hypochlorite leaks from make vats, transfer lines, or storage tanks?	A sodium hypochlorite leak would not result in a chlorine release.	None.	1A
5. The pipes or vessels overheat?	There are no heat sources within the sodium hypochlorite system except for the sodium hypochlorite make reaction itself. Vessels are equipped with temperature sensors. If the preset temperature set point is exceeded, an audible alarm is automatically activated and an automatic shutoff valve stops the flow of chlorine. This immediately stops any overheating that may occur. This mitigation system is backed up by manual Plant Emergency Stops (E-Stops) located throughout the plant.	None. The control and monitoring systems currently in place are considered adequate.	2A
6. The system over-pressurizes?	There are no pressure sources within the system except for the chlorine supply itself. Over-pressurization is not practically possible.	None.	1A
7. There is a power failure?	System shutdown.	None. Emergency shutdown and startup procedures are in place.	1A
8. Human error occurs?	The ORP and temperature of the solution is monitored during the production process, therefore	None. The control and monitoring systems currently in place are	1A

What If?	Consequence	Recommendation	Scenario Rank
	human error would not likely result in a release of chlorine.	considered adequate.	

TABLE 12.a.5 - Results of the External Events Analysis

EVENT	CONSEQUENCE	RECOMMENDATION
1. Aircraft impact	If it impacted the rail car storage area, a release of the entire contents of up to (number) rail cars of chlorine and or (number) rail cars of sulfur dioxide could occur.	None. The facility is (number) miles from (name of airport). Commercial planes (do/don't) fly over the facility on a routine basis (i.e., the facility (is/isn't) in a flight path). However, the possibility of aircraft impact is considered remote (extremely unlikely).
2. Avalanche	No release would be expected.	None. The facility and its delivery area are not in an avalanche area.
3. Coastal erosion	No release would be expected.	None. The facility is located in an inland area. Therefore there is no potential for coastal erosion to impact the facility.
4. Drought	The facility uses water to formulate bleach and sodium bisulfite, and for cooling processes. During severe droughts, the plant water supply may be curtailed. In an extreme case, if the water supply were completely cut, bleach and sodium bisulfite production would be discontinued for some time.	None.
5. External flooding	No release would be expected.	None. There are no bodies of water adjacent to the facility.
6. Extreme winds or tornadoes	High winds could cause filled containers to be damaged, resulting in a release of chlorine and or sulfur dioxide.	None. The facility (is/isn't) located in a tornado area. The major impact if a tornado did occur would be high wind damage.
7. Fire	Container fuse plugs could fail resulting in the release of the entire contents of the container.	None. There is a (wet/dry) sprinkler system in the (plant/warehouse/office) (delete this sentence if your facility does not have one). Fire extinguishers are located throughout the plant and the employees receive annual training in their use. In addition, all flammable materials are properly stored in flammable cabinets.
8. Fog	No release would be expected.	None. Occasional heavy fog occurs in this area for short periods, usually early in the day. When this occurs, operations, including deliveries, are suspended until the fog lifts.
9. Forest fire	Not applicable.	None. The facility is not located

EVENT	CONSEQUENCE	RECOMMENDATION
		near a forest.
10. Frost	Extreme frost may freeze some pipes, PVC pipes may become brittle and as a consequence may break at a later time resulting in a release.	None. After a frost occurs, all system components (piping, valves, etc.) are inspected prior to beginning filling or transfer operations.
11. Hail	No release would be expected.	None. Historically hailstorms are infrequent and not severe.
12. High tide/High lake/High river	No release would be expected. See Item 5 above.	None. See Item 5 above,
13. High summer temperatures	The maximum summer temperature for the area is (X)°F. Prolonged direct exposure of chlorine and or sulfur dioxide containers to the sun could be a hazard.	None.
14. Hurricane	No release would be expected.	None. The facility (is/isn't) in a hurricane area. The major impact if a hurricane did occur would be flooding. See Item 5 above.
15. Ice cover	No release would be expected.	None. See Item 10 above.
16. Industrial or Military facility accident	The facility may need to be evacuated. It would take about 30 minutes to shut down the chlorine and sulfur dioxide systems. No release would be expected.	None.
17. Internal flooding	No release would be expected.	None. The possibility for internal flooding (broken water line, etc.) is considered remote.
18. Landslide	No release would be expected.	None. The facility is not located in a landslide area.
19. Lightning	No release would be expected.	None. Facility equipment is adequately protected.
20. Low lake or river level	No release would be expected. See Item 5 above.	None. See Item 5 above,
21. Low winter temperature	No release would be expected.	None. The lowest average temperature that occurs during the winter is (insert temperature). Chlorine and sulfur dioxide are not affected because the minimum freezing point of any of the two compounds is -102F (-74C) and the minimum boiling point of any of the two compounds is 14F (-10C).
22. Meteorite impact	If it impacted the rail car storage area, a release of the entire contents of up to (number) rail cars of chlorine and (number) rail cars of sulfur dioxide could occur.	None. Extremely unlikely.
23. Missile impact	If it impacted the rail car storage area, a release of the entire contents of up to (number) rail cars of chlorine and (number) rail cars of sulfur dioxide could occur.	None. Extremely unlikely.
24. Nearby pipeline	No release would be expected.	None.

EVENT	CONSEQUENCE	RECOMMENDATION
accident		
25. Intense precipitation	No release would be expected.	None. See Item 5 above.
26. Release of chemicals from on-site storage	No release of either chlorine or sulfur dioxide would be caused by the release of any other chemical from on-site storage. In an accident or release of chemicals, the operators, crew members, Plant Manager, and Branch Manager are informed of the event through (describe). The failed system is isolated and emergency evacuation procedures are implemented if necessary. The facility personnel including all administrative employees participate in emergency evacuation drills. Each member of the emergency response team is assigned duties and responsibilities. Primary and secondary staging areas have been evaluated to allow for easy escape in case of wind shifts. A general alarm system is installed throughout the facility to supplement the intercom.	None.
27. River diversion	No release would be expected. See Item 5 above.	None. See Item 5 above.
28. Sabotage	An act of sabotage could result in the release of a large amount of chlorine and or sulfur dioxide.	None. In accordance with JCI's security program and specifically our access control program and inspection procedures applicable to railcars and trailers loaded for delivery, it is unlikely that an act of sabotage could be committed without being identified at the branch.
29. Sandstorm	No release would be expected.	None. The facility is not in a sandstorm area.
30. Seiche (lake wave)	No release would be expected. See Item 5 above.	None. See Item 5 above.
31. Seismic activity	The facility is not located in a seismically active area. **OR** The (state the area) is on a fault line indicating the potential for seismic activity of substantial magnitude. Although the potential is there, the frequency of this is rare.	None. **OR** We have flex connections on all lines that carry hazardous product to production facility.
32. Shipwreck	No release would be expected. See Item 5 above.	None. See Item 5 above.
33. Snow	No release would be expected.	None. See Item 10 above.
34. Soil shrink, swell, or consolidation	No release would be expected.	None.
35. Storm surge	No release would be expected.	None.
36. Terrorist attack	A terrorist attack could result in the release of a large	None. See Item 28 above.

EVENT	CONSEQUENCE	RECOMMENDATION
	amount of chlorine or sulfur dioxide.	
37. Transportation accident	A transportation accident could result in a release of the entire contents of several containers.	None. On site and off site accidents are always a possibility. All drivers who carry HHCs have the proper licenses (Commercial Drivers License [CDL] with Hazardous Material [HazMat] endorsement as required by the US Department of Transportation (DOT). Each driver receives extensive training regarding the HHCs to be transported. In the event of an accident the driver notifies the local emergency response agency and the facility. Each facility has a trained response team. Additionally the containers for all HHCs are manufactured and maintained in accordance with DOT specifications and regulations.
38. Tsunami (tidal wave)	No release would be expected. See Item 5 above.	None. See Item 5 above.
39. Toxic gas	No release would be expected. See Item 26 above.	None. See Item 26 above.
40. Turbine generated missile	No release would be expected.	None. There are no turbines onsite.
41. Volcanic activity	Not applicable.	None.
42. War	War could result in the release of a large amount of chlorine and or sulfur dioxide.	None. See Item 28 above.
43. Waves	No release would be expected. See Item 5 above.	None. See Item 5 above.

WHAT IF?	CONSEQUENCE	RECOMMENDATION	SCENARIO RANK
1a. Changes in system status are not communicated between employees when employees change tasks; i.e., if an employee begins a task, is called away, and returns after another employee has stepped in and performed part or all of the task originally being performed by the first employee.	The consequence of this is that due to a lack of communication between employees, a function may be performed that can result in the release of chlorine.	In an environment of overlapping responsibilities, it is recommended that management stress to all employees the importance of close communication between employees so as to ensure that situations do not develop that have the potential to result in a release of chlorine. The example to be used here is again, an employee blows down and vacuums a cylinder but before it can be removed from the blowdown station, he is called away and another employee comes in, moves the cylinder to the valve machine and puts another cylinder on 'blow'. The original employee returns and thinking the cylinder connected is the one he already blew down and vacuumed, disconnects it, moves it to the valve machine, and removes the valve.	2A
2a. There is a power failure.	In the event of a loss of power, the entire compressed gas repackaging system, to include the railcars, shuts down; i.e., all actuated valve close thereby shutting down the flow of compressed gas.	None as the mitigation system is designed to shut down in the event of a loss of power. It must be understood as part of this, that the air system will also shut down, resulting in the closure of all actuated valves in the compressed gas system.	1A

FIGURE 12.a - Description of Qualitative Rankings

SEVERITY OF CONSEQUENCE

Rank	Examples of Severity
Low	Chemical is expected to move into the surrounding environment in negligible concentrations. Injuries expected only for exposure over extended periods of when individual personal health conditions create complications.
Medium	Chemical is expected to move into the surrounding environment in concentrations sufficient to cause serious injuries and/or deaths unless prompt and effective corrective action is taken. Death and/or injuries expected only for exposure over extended periods or when individual personal health conditions create complications.
High	Chemical is expected to move into the surrounding environment in concentration sufficient to cause serious injuries and/or deaths upon exposure. Large numbers of people expected to be affected.

LIKELIHOOD OF OCCURRENCE

Rank	Examples of Likelihood
Low	Probability of occurrence considered unlikely during the expected lifetime of the facility assuming normal operation and maintenance.
Medium	Probability of occurrence considered possible during the expected lifetime of the facility.
High	Probability of occurrence considered sufficiently high to assume event will occur at least once during the expected lifetime of the facility.

FIGURE 12.a.1 - Results of the Qualitative Rankings for the Chlorine Repackaging System

SEVERITY OF CONSEQUENCE

3	HIGH	1, 2, 7, 10, 18, 19, 23, 24, 26, 39		
2	MEDIUM	3, 4, 5, 6, 9, 20, 21, 28,2a	11	
1	LOW	8, 12, 16, 17, 22, 25, 27, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 1a	14, 15	13
		LOW A	MEDIUM B	HIGH C

LIKELIHOOD OF OCCURANCE

FIGURE 12.a.2 - Results of the Qualitative Rankings for the Chlorine Storage and Distribution System

SEVERITY OF CONSEQUENCE	LOW A	MEDIUM B	HIGH C
3 HIGH	1, 5, 6, 8, 10, 11, 12, 13		
2 MEDIUM	2, 3, 4, 7, 9		
1 LOW			

LIKELIHOOD OF OCCURANCE

FIGURE 12.a.3 - Results of the Qualitative Rankings for the Sulfur Dioxide Storage and Distribution System

SEVERITY OF CONSEQUENCE		LIKELIHOOD OF OCCURANCE: LOW A	MEDIUM B	HIGH C
3	HIGH	1, 5, 6, 8, 10, 11, 12, 13		
2	MEDIUM	2, 3, 4, 7, 9		
1	LOW			

FIGURE 12.a.4 - Results of the Qualitative Rankings for the Sodium Hypochlorite Manufacturing System (Make Vats)

SEVERITY OF CONSEQUENCE				
3	HIGH			
2	MEDIUM	1, 2, 3, 5		
1	LOW	4, 6, 7, 8		
		LOW A	MEDIUM B	HIGH C
			LIKELIHOOD OF OCCURANCE	

SECTION 13
RECOMMENDATIONS

As a result of the PHA, the following recommendations were made:

(LIST ALL RECOMMENDATIONS MADE)

1. Determine how the facility will notify local residents and/or businesses in the immediate vicinity of the branch in the event of a catastrophic failure of a railcar (i.e., does the branch participate in a community alert network, does the local 911 center have a reverse 911 system, is the notification handled by the local emergency response agencies such as the Police Department, is the notification a coordinated effort between the branch and the local emergency response agencies, etc.).

2. Review procedures to ensure that the potential for overfilling of 150 pound cylinders is properly addressed and that all cylinder fill stations have automatic shutoffs.

3. Ensure that all emergency response equipment is properly stored when not in use.

APPENDIX A-Documentation of Actions Taken

Recommendation	Action to be Taken	Date to be completed	Responsible Person	Date Completed / Initial	Communicated to Staff?
Determine means of notifying residents and or businesses in close proximity to the Branch in the event of an emergency.	Contact the Ladysmith Hazmat Unit to discuss.	30 April 2009	Michael Washington	30 April 2009	Yes
Review procedures to ensure that the potential for overfilling of 150 lb cylinders is properly addressed and that all fill stations have automatic shutoffs.	Verify the existence of automatic shutoff systems on cylinder scale and that it works properly.	30 April 2009	Michael Washington	30 April 2009	Communicated to staff on 30 April 2009.
Ensure that all emergency response equipment is properly stored when not in use.	Verify that this is included in the Monthly Safety Equipment Inspection	30 April 2009	Michael Washington & James Wright	30 April 2009	As necessary